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FUNDAMENTAL PRINCIPLES OF AEROBIOLOGICAL RESEARCH

Beispiele Angewandter Forschung
Sonderdruck (special edition)
1961, 4 pages

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The increasing atmospheric pollution by dusts, gases and vapors merely emphasizes the urgent need for research on aerosols.

Based on the results of aerosol research in Medicine, the emphasis has now shifted to the investigation of biological effects of damaging, atmospheric pollutants. It has become possible, technically and reproducibly, to simulate atmospheric pollution in animal experiments. This has opened the way for searching and finding methods for the prevention, or, at least, for a lessening of biological reactions induced by aerosols.

Applied aerosol research inevitably requires methods for producing, assaying and filtering aerosols, etc. In Biology, we are dealing with medical, pharmacological, physiological and pathological problems. Unfortunately, questions in Physical Chemistry have remained unanswered.

In 1959, the Institute of Aerobiology, associated with the Fraunhof Society, began efforts in that direction. It was necessary to form a multidisciplinary group of researchers because of the multiplicity of tasks involved.

The newest methods and findings were used to set-up the technical and instrumental organization of the institute and only after thorough discussions and experimental constructions.

Within the framework of research on the biological effects of damaging industrial aerosols, methods were developed by which pollutants of the atmosphere could be analyzed. Emphasis was placed on resorption phenomena

of aerosolized particles in the sumbicroscopic range and on the interaction of different aerosol components responsible for biological damages.

Fundamental Principles of Aerobiological Research

With increasing industrialization, industrial wastes affect the environment of the people who are engaged in the industrialization. The increasing load of atmospheric pollution by gases and volatiles of different kinds presents a problem which threatens biological existence whenever emission into the atmosphere (industrial pollution) can no longer be sufficiently diluted. When the regional concentrations of damaging pollutants exceed the margin of safety, we may encounter catastrophies similar to the ones that occurred at Donora, London, St. Louis and Pittsburgh.

At the threshold of the atomic age we can no longer speak of clean air. Even the demand for dust-free air has become meaningless after the discovery of cosmic dusts. A few voices insist that the demands of modern civilization and industrial development make atmospheric pollution unavoidable, while other voices claim men, animals and plants will adapt to a certain extent to the atmospheric pollution. In this arena of conflicting opinions I should like to add my opinion on air pollution and stress elastically formulated limits of safety which must not be exceeded.

There exist beside natural aerosols, i.e. solid, liquid or gaseous contaminants of air, two other industrial sources of aerosols. One includes the external combustions necessary for the production of heat and energy and their by products, e.g. smoke, ashes, sulfur oxides, which enter the atmosphere. The other includes the internal combustion products which originate from the raw materials that are used during industrial production. These account for the largest amount of pollutants and are primarily responsible for atmospheric contaminations.

During the last few years, undoubtedly much has been learned about the biological damage done by individual aerosol fractions which often combine to produce toxic compounds and mixtures of compounds. The problem of aerial contamination has become very complex because of the multiplicity and numerous possible combinations of byproducts and their influence on living things. Therefore, exact definition becomes impossible.

All measures for minimizing atmospheric contamination must start with the control of aerosols or their emissions. This is a technical problem. The task of biological research on aerosols is to identify the pollutants and their effects on man and his environment and to neutralize this effect. Here, we are just making a start. Even the reports about the great aerosol disasters did not provide a detailed picture of the specific causes that were responsible for the death of many people. Consequently, we restricted ourselves to finding limits of safety which, when exceeded, constitute pollution of the human environment. A knowledge of regional atmospheric pollution and diffusion processes (exchange and interaction) is essential and it

can be obtained from measurements of many, typical sampling points. These measurements must be evaluated in collaboration with researchers in related fields in order to understand the dynamics of aerosol interactions. When aerosols of unequal chemical origins, but typical physical characteristics, become mixed, then numerous divergent reactions may occur. The pollutant in question becomes aerobiologically modified with time and may become toxic for humans.

This is a fundamental problem which requires urgent attention. It will permit a determination of the effect of aerosol particles in the respiratory tract of animals. Only when this will be known will tolerances for aerosols become meaningful and their determination will become possible under divergent conditions.

Thus far, emphasis has been towards medical, hygienic, preventive measure, mostly combatting dust. Eliminating or reducing the output of industrial, volatile byproducts is similar to eliminating liquid or solid wastes. The attention of the public was more or less directed towards the increasing pollution of air. However, medically, there was no clear-cut evidence that health was damaged because of atmospheric pollution in general, although the biological dangers of certain aerosol fractions became evident when threshold concentrations were exceeded. Damaging aerosols are invariably present as mixtures which, when acting together, become very toxic for man. The causes will be most easily found in the area of toxicology for a given industry. The area of atmospheric pollution that is hygienically damaging for everybody is still unexplored.

It must be stressed that a definition of the permissible concentration of toxic aerosols is, at best, crude. However, fewer undesirable reactions occur below the permissible limits. To translate M.A.C. values (representing maximum permissible concentrations of admixtures in air) to the conditions prevailing in the Ruhr area would be an expensive and one-sided suggestion. The M.A.C. limits were not considered to be binding values in the Donora and London episodes, because the prevailing toxic aerosols (especially the poisonous byproducts) were below threshold values. This is not surprising in view of known facts because the prevailing conditions cannot be characterized by the concentrations of aerosol fractions alone. In order to estimate the degree of danger of certain emissions, until now only their chemical origin had been considered, to a much lesser extent the possibility of dynamic interactions which, in time, might adversely affect living organisms. A single source of emission may be unimportant biologically. Only when several aerosol fractions meet and interact chemically will it become possible for conditions to develop which may have serious consequences for the biological existence of living organisms.

The concept of atmospheric safety must consider first of all the health needs of the population, then the needs of the industry. Even when a certain industrial atmospheric pollution becomes technically unavoidable,

one must insist that the safety limit of the concentration must not be reached, even when the aerosol components chemically interact. To put this more precisely: pollutants must not exceed the safety value for people, animals and plants. In other words, the possibility to do damage through atmospheric pollution must remain only a calculated risk, even in the worst case.

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